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ABSTRACT

In an attempt to provide technically adequate screening with criteria for referring children for further evaluation, the Diagnostic Index (DI) was developed. The DI expresses the relationship between a child's chronological and developmental ages, identifies as a percentage of normal development the discrepancy between age appropriate behaviors and the behaviors the child exhibits. Testing of the DI indicated that when used with recommendations from the screening team, the DI substantially decreased the probability that delayed preschoolers would be overlooked during the screening phase. Among considerations in using the DI are that the DI should be computed within and across domains to reveal a more accurate and reliable picture of the child's functioning and that the cutoff point should be moved upward to safeguard against overlooking delayed preschoolers. (CL)

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The Diagnostic Index: A Criterion for Further Evaluation and Intervention with At-Risk Preschool Children

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Running Head: Diagnostic Index

Abstract

Standardized criteria for referring preschool children for follow-up evaluation and intervention after screening are virtually nonexistent. The Diagnostic Index (DI) is proposed in this article as one criterion. The DI relates a child's chronological age to his or her developmental age (s) received on a screening device and describes the relationship between age appropriate behaviors and the behaviors the child is actually exhibiting in the form of a percentage of normal development. Procedures for computing the DI are outlined in this article. Data describing the effectiveness of the DI with children screened in a small city/county school system in a southern state are also discussed.

The Diagnostic Index: A Criterion for Further Evaluation and Intervention with At-Risk Preschool Children

Introduction

Periodic screening of preschool children is often used by professionals to identify children who are at-risk of exhibiting learning problems when they enter school. Support for screening programs came from the federal government through the creation of the Early Periodic Screening, Diagnosis, and Treatment program (EPSDT) established in 1967 by Public Law 90-428. Continued support for such programs was affirmed through enactment of Public Law 94-142, the Education for All Handicapped Children Act of 1975. This federal legislation mandated the development of programs including (a) statewide Child Find programs to help screen for at-risk preschoolers and (b) the preschool Incentive Grant Program to help states initiate, improve, and expand services to these children (Johnson, 1981).

Screening: Definition and Difficulties

Technically, screening refers to the global process of studying the behavior of young children in an attempt to identify learning-related problems, usually in the areas of gross motor, fine motor-adaptive, language, and personal-social development. A number of instruments designed for this purpose are available, such as the Denver Developmental Screening Test (DDST) (Frankenburg & Dodds, 1975).

Once children are screened the decisions to be made include (a) passing children who present no problems, (b) rescreening children who might have performed poorly due to extraneous reasons, such as a cold, or (c) referring

children who exhibited problems during screening for further, more comprehensive evaluation (Zehrbach, 1975). Usually, these decisions, based on the information collected during the screening phase, are made by an interdisciplinary team consisting of educational consultants, speech and hearing therapists, and other professionals as determined by the extensiveness of the screening program (Clunies-Ross, 1979).

A decision to pass a child who has demonstrated average or above average development or to rescreen a child who has responded inconsistently during the initial screening phase is made with moderate ease by the interdisciplinary team. Difficulties arise, however, when these professionals attempt to make decisions regarding which children already screened require more comprehensive evaluation and intervention (Meisels, Note 1). The greatest difficulty concerns referring children in the 3-to 5-year-old age group who exhibit mild to moderate delays in one or more areas of development. Professionals have attempted to use existing criteria for further evaluation such as at-risk registers of prenatal, perinatal, and postnatal stress (Alberman & Goldstein, 1970), matrix analysis (Gallagher & Bradley, 1972), and cumulative score designs (Parmelee, Sigman, Kopp, & Haber, 1976). Recent evidence, however, suggests that these procedures are inappropriate for this age group and can result in decisions which subsequently lead to identifying children who are not developmentally delayed (false positives) and missing children who are developmentally delayed (false negatives) (Kochanek, 1980).

Another problem which seriously restricts valid referral of children is the technical inadequacies found in some screening instruments, particluarly in norms and with reliability and validity (Children's Defense Fund, 1978). Norms, in general, often reflect disproportinate numbers of white children from families with professional, managerial, and sales backgrounds. Such norms are considered to be inappropriate for poor, black, Latino, Oriental,

Native-American, and Chicano populations. Statements questioning reliability and validity are based on the contention that the behavioral descriptions on most screening devices are focused on a very narrow age range and, as a result, contribute indirectly to diagnosing children falsely (Meier, 1976). Further, screening instruments are inappropriate for identifying instructional goals and placing children within a curriculum. More detailed assessments must be undertaken for these purposes (Neisworth, Willoughby-Herb, Bagnato, Cartwright, & Laub, 1980).

Professionals from several different disciplines have called attention to the critical need to establish criteria for referring children for further evaluation and have expressed concern over the technical inadequacies found in some screening instruments. Zehrbach (1975) concluded that a child should be referred for additional testing if he or she is functioning somewhat below average, in general, at a cutoff point, defined as the threshold between normal and abnormal development, that is equal to or less than 75-80% of the average. Others (Mercer, Algozzine, & Trifiletti, 1979; Ullman & Kausch, 1979) have reported an even wider range of 70-90%. Educators tend to agree on the need to establish cutoffs. For example, the Children's Defense Fund (1978) suggested that cutoff points might be useful in determining preschoolers who are in need of more extensive testing after screening. However, precise, objective methods which consider the relationship between the child's chronological age and developmental age, in conjunction with the cutoff point, are essential. To partially fullfill the need for objective methods, this article offers the Diagnostic Index (DI).

The Diagnostic Index:

Calculation and Effectiveness

The Diagnostic Index (DI): (a) relates a child's chronological age to his or her developmental age(s) received on a screening device; (b) describes

the discrepancy between age appropriate behaviors and the behaviors the child is exhibiting in the form of a percentage of normal development; and (c) serves as a criterion for determing which children already screened require further evaluation and intervention. The DI is expressed as:

$$\frac{\text{Developmental Age (DA) in Months}}{\text{Chronological Age (CA) in Months}} \times 100 = \text{Diagnostic Index (DI)}$$

Calculating the DI

Norm-referenced instruments, such as the Learning Accomplishment Profile (LAP) (Sanford, 1975), from which developmental ages can be generated, are administered to children during the screening phase, often as part of a Child Find program. On other screening devices that do not depict developmental ages the developmental age is defined as the point just before the child gets two consecutive failures (McCarthy, Lund, & Bos, 1983). Developmental ages must be determined within domains (i.e., language) and across domains. Across domains is computed by averaging the developmental ages within domains. Each developmental age in months is then divided by the child's chronological age in months. The results, multiplied by one-hundred, is the DI expressed in the form of a percentage. Following is an example of how the DI is used to aid in referring a child for follow-up evaluation.

Coordinators of a federally funded outreach program designed to screen for at-risk preschoolers set its cutoff point at 80%, based on longitudinal data collected during previous screenings and recommendations from literature on similar screening programs. This outreach program used a variety of screening measures including the DDST, tests of visual and auditory acuity and speech articulation, medical data, and information from parents. The screening results for one child, Craig, are reported in Figure 1. DIs were computed on the DDST across domains and within domains: gross motor, language, fine motor-adaptive, and personal-social. The results indicated that although Craig's DI across domains was 81%, he received DIs of 78%

in personal-social and 73% in language. It was recommended that Craig receive further evaluation in language and personal-social skills to determine the extent of developmental delay in these areas. In addition periodic rescreening in other areas was recommended based on the fact that Craig was 81% across domains, a rate 1% higher than the established cutoff point.

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Insert Figure 1 About Here

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Effectiveness of the DI

To determine the potential usefullness of the DI, results from a screening program to identify at-risk preschoolers in a small city/county school system (approximately 3,000 enrollment) in a southern state were analyzed post hoc. Such retrospective analysis was performed also by Parmalee, et al (1976). Like the outreach program mentioned in the above section, this school district used a variety of screening measures including the DDST, on which the cutoff point was 80%. The screening results on a random sample (N=27) of the 4½-and 5-year-olds screened during the 1976-77 school year were analyzed to determine if: (a) application of the DI, in addition to traditional criteria (i.e., recommendations of the interdisciplinary team only), resulted in referring a greater percentage of children and (b) follow-up analysis revealed whether children missed during the initial screening phase in 1976 were being referred for special education services during grades K-4.

The results, shown in Table 1, indicated that 4 (14%) more children would have been referred for further evaluation if the DI were used in conjunction with traditional criteria. Follow-up study of these children during grades K-4 indicated that of the four children (numbers 4,7, 18, and 19) overlooked because of the utilization of traditional criteria only, 2, about

7% of the sample, although not referred to special education, were exhibiting mild to moderate academic problems, especially in reading. The other two were doing fair and average work, respectively. Clearly, utilization of the DI would have resulted in referring children for further evaluation who were determined not to be developmentally delayed, a phenomenon discussed in the next section. In contrast, utilization of traditional criteria only resulted in missing children who subsequently exhibited some degree of learning difficulty during grades K-4.

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Insert Table 1 About Here

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Important Considerations

The DI is a useful way of helping to determine when children should be referred for further evaluation and intervention. There are, however, several important factors that should be considered when utilizing the DI.

First, the DI should not serve as the absolute criterion for child referrals, but should be considered along with recommendations of the team members who participated in the screening phase, as shown in Figure 2. Additional factors to consider include medical information, parent interviews and ecological assessments, and social worker reports.

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Insert Figure 2 About Here

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Second, the DI must be computed within and more importantly, across domains. Within domains permit comparisons across domains and helps detect possible delays in specific areas. For example, Craig showed "normal" growth on the entire DDST however, in the language and personal-social areas less progress was detected. An across domains computation reveals a "total

picture" of the child and is more reliable, since screening instruments often reflect inadequate samplings of behaviors within domains. To enhance identification screening instruments must be chosen whose norming sample is representative of the population to be screened and which furnish data on reliability and validity (Katoff & Reuter 1980).

Third, the strength of the DI as a partial determinant for further study of the child has its roots in the reliability of the cutoff point. While review of literature is helpful initially in establishing a cutoff point, factors as socioeconomic status (SES) of the target population and data from previous screening attempts must be considered also (Hayden 1979). As stated, some researchers consider 75-80% as an accurate cutoff for most at-risk preschoolers (i.e., Zehrbach, 1975). Others (i.e., Mercer, Algozzine, & Trifiletti, 1979) have reported an even wider range of 70-90%. It must be remembered, however, that any attempts to raise the cutoff can result in false positives; lowering the cutoff contributes to false negatives, which is unacceptable. In summarizing the effects of raising or lowering the cutoff point, Gallagher and Bradley (1972, p. 92) stated that "the choice of the cutoff point is always a balance between these two extremes." As a safeguard against missing delayed preschoolers, the cutoff point should be moved upward slightly even at the risk of including nondelayed preschoolers. Identification of children who are not delayed is tolerable during screening if comprehensive follow-up assessment determines that these children are not delayed. A residual effect of including nondelayed children is the identification of more low-risk children (Figure 2). Some researchers (i.e., Parmalee, et al, 1976) believe that it is ineffecient to identify nondelayed children because of the costs involved in follow-up evaluation. Yet, studies have shown that any attempts to identify and remediate preschoolers, both low-risk and high-risk, is a worthwhile activity that might subsequently add to the quality of their lives and produce citizens who

who are assets rather than burdens to the community (Meier, 1976).

Finally, since the DI determines if there is a discrepancy between chronological age and developmental age, it must be classified as a deficit score index and, consequently, is subject to the constraints inherent in such methodology (Salvia & Clark, 1973; Salvia & Ysseldyke, 1978). For example, the DI neither facilitates recommendations about which programs of intervention are needed by particular children nor does it help in developing program goals and objectives. More comprehensive instruments and techniques are needed for these purposes. Further, the DI should not be used even in cooperation with other criteria to classify children. The purpose of the DI is to serve only as a criterion for helping determine when children require further, more comprehensive evaluation, an area where few standardized criteria currently exist (Bagnato, Neisworth, & Eaves, 1978; Bagnato & Neisworth, 1980).

Conclusions

A Rand Corporation Report concluded that there were several problems which surrounded current screening attempts (KaKalik, Brewer, Dougherty, Fleuschauer, Grenewsky, & Wallen, 1974). Among those were: (a) large numbers of children remained undetected; (b) many children were misidentified; (c) there were inadequate follow-up services for children identified as having a suspected handicap; and (d) there were insufficient trained personnel to work with children. These difficulties, along with attendant problems concerning the effectiveness of some screening and evaluative instruments, make indentifying at-risk preschoolers a formidable task. Therefore, techniques which increase the effectiveness of the screening process must be identified.

The use of standardized criteria for referring children after screening for follow-up evaluation and intervention would be one way to increase the effectiveness of the screening process. Such criteria are essential to prevent

missing preschoolers who are at-risk of experiencing academic problems when they enter school. This article proposed the Diagnostic Index (DI) as one such criteria. When used in conjunction with recommendations from the screening team, the DI substantially decreases the probability that delayed preschooler can be missed during the screening phase.

While much of this article is based on experimental, largely clinical application of the DI, the results have implications for the screening process. Further research is underway with larger sample sizes. Research questions currently being investigated are: (a) What scales lend themselves to the DI; (b) What cut-off points seem optimal; (c) Can the DI be extended to later childhood screening (e.g., Kindergarten and first grade)? Any of these issues, properly explored, can add greatly to the importance of the DI as a technique which enhances identification of at-risk children.

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SCREENING RESULTS

Child's Name Craig

Parent(s) _____

Birthdate 12-29-77

Address _____

Date of Screening 1-17-81

Chronological Age (CA) 37 mos.

Telephone Number _____

School (if appropriate) none

Referred by social worker

Instrument Used Denver Developmental Screening Test (DDST)

$\frac{DA}{CA} \times 100 = DI$

Variables	Developmental Age (DA) in months	Diagnostic Index (DI)
1. Developmental Domains		
a. Gross Motor	31	84%
b. Language	27	73%
c. Fine Motor-Adaptive	32	86%
d. Personal-Social	29	78%
2. Across Domains (Entire Instrument)	30	81%

Recommendations Further evaluation in language and personal-social skills

Periodic rescreening every three months.

Recommendations made by: _____ Position _____

Date _____

Figure 1. Illustration of DI utilization with a potentially at-risk preschooler

TABLE 1

Comparison of Traditional (TRAD) and Diagnostic Index (DI) Referrals From Results on the Denver Developmental Screening Test (DDST)

	Across DDST Domains		Within DDST Domains							
	Entire Instrument		Gross Motor		Language		Fine Motor-Adaptive		Personal-Social	
Child	TRAD	DI	TRAD	DI	TRAD	DI	TRAD	DI	TRAD	DI
*1		X	X	X	X	X	X	X		X
*2	X	X		X	X	X		X		X
3										
*4						X		X		
*5					X	X				
6										
*7						X		X		
8										
9										
10										
*11	X	X			X	X	X	X		X
12										
13										
14										
15										
16										
17										
*18						X				
*19								X		
20										
21										
22										
*23	X	X		X			X	X	X	X
24										
25										
26										
27										
Total Referrals	3	4	1	3	4	7	3	7	1	4
Percentages	11	15	4	11	15	26	11	26	4	15

* Required follow-up evaluation.

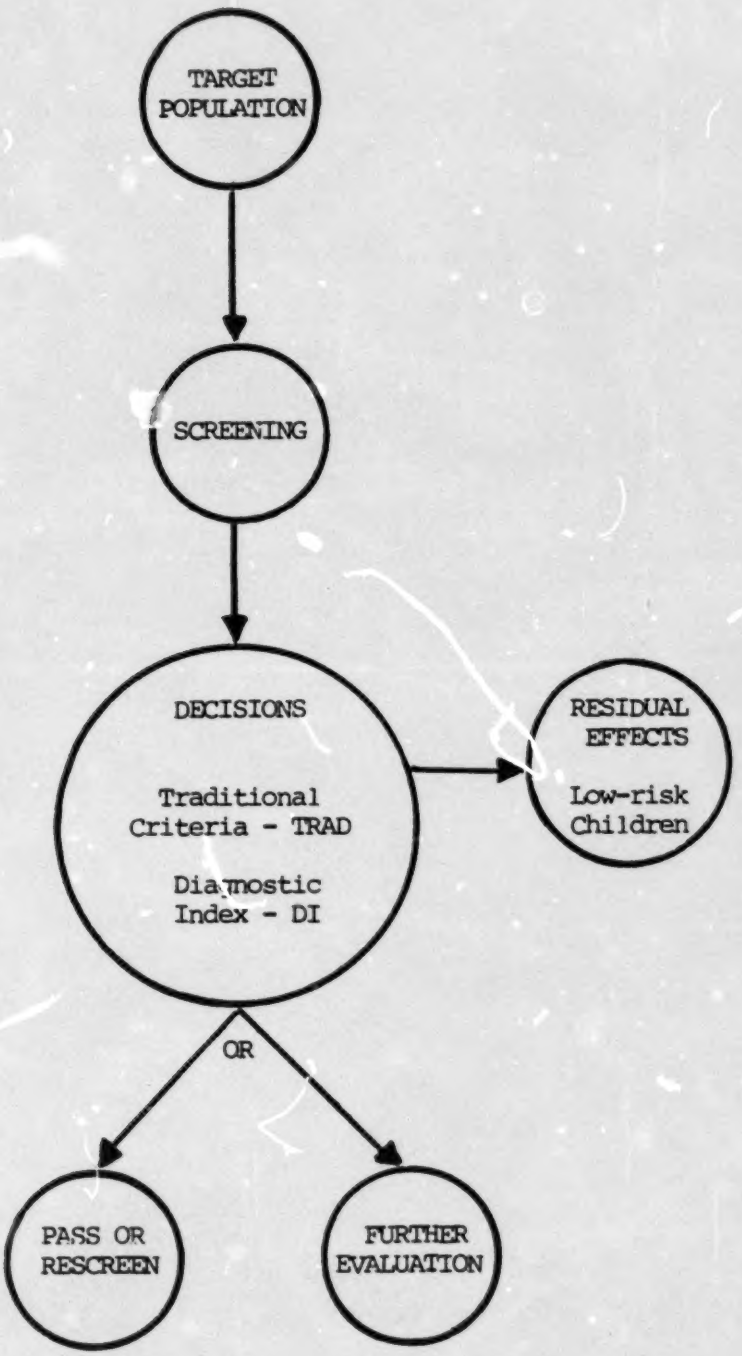

Figure 2. Decision model when using the Diagnostic Index (DI) with Traditional Criteria (TRAD).